

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2004-188420

(43)Date of publication of application : 08.07.2004

(51)Int.Cl.

B22D 11/00
 B22D 11/10
 B22D 11/103
 B22D 11/18
 B22D 21/04
 B22D 37/00
 B22D 41/14
 B22D 41/22
 B22D 41/50

(21)Application number : 2002-355324

(71)Applicant : SUMITOMO METAL IND LTD

(22)Date of filing : 06.12.2002

(72)Inventor : MURAKAMI TOSHIHIKO

MIZUKAMI HIDEO

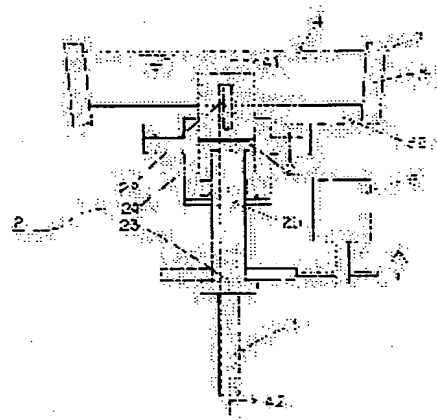
ISHIKAWA MINORU

(54) METHOD AND APPARATUS FOR CONTINUOUSLY CASTING MOLTEN MAGNESIUM ALLOY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a method and an apparatus for continuously casting a magnesium alloy with which molten metal can be cast at a low cost under good flowing rate control.

SOLUTION: In the method for continuously casting the molten magnesium alloy 4 into a mold through a molten metal holding vessel 3 to form a cast slab, a molten metal flowing rate control part 21 having an opening hole part 22 for making flow of the molten metal in the molten metal holding vessel into the molten metal flowing rate control part 21 and an opening hole part 23 for making flow of the flowing molten metal into the mold, is controlled to the molten metal flowing rate supplied into the mold by advancing and retreating this control part into the molten metal holding vessel.



LEGAL STATUS

[Date of request for examination]

16.12.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the
 examiner's decision of rejection or application converted
 registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of
 rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

Best Available Copy

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.*** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]

It is the continuous casting approach which supplies a Magnesium alloy molten metal in mold through a molten metal maintenance container, and is made into a cast piece. It lets the internal surface of said molten metal maintenance container pass for the molten metal control-of-flow section which has opening for opening and the molten metal which flowed for the molten metal in said molten metal maintenance container to flow into molten metal control-of-flow circles to flow into said mold. The continuous casting approach of the Magnesium alloy molten metal characterized by controlling the molten metal flow rate supplied in said mold by making it advance or retreat in a molten metal maintenance container.

[Claim 2]

It is continuous-casting equipment of the Magnesium alloy molten metal which is continuous-casting equipment of the Magnesium alloy molten metal which has a molten metal maintenance container, the molten metal control-of-flow section, and mold, and is characterized by for said molten metal control-of-flow section to have opening for opening and the molten metal which flowed for the molten metal in said molten metal maintenance container to flow into the molten metal control-of-flow section to flow into said mold, and to install it through the internal surface of said molten metal maintenance container so that penetration and retreat may be possible in a container.

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. *** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to the continuous casting approach which can perform good control of flow of the Magnesium alloy molten metal to the mold for continuous casting, and continuous casting equipment equipped with said control-of-flow device.

[0002]

[Description of the Prior Art]

In the practical use alloy, smallest [specific gravity], since rigidity is high, the Magnesium alloy is widely used for the cellular phone etc. by the aircraft and the automobile pan. Especially, as for a Magnesium alloy commercial scene, growth is expected further, it is cheap and offer of the Magnesium alloy of high quality is desired by the rapid spread of cellular phones etc.

[0003]

Since the reactivity of a Magnesium alloy in an elevated temperature is high, and it is easy to oxidize and it easy to absorb hydrogen, when the molten metal of a Magnesium alloy is exposed to the bottom of an atmospheric-air ambient atmosphere at the time of the dissolution or continuous casting, oxidation promotes, an oxide will generate, or oxygen and hydrogen will be absorbed in the dissolved Magnesium alloy, and those concentration will rise remarkably. Thus, if the concentration of the oxygen in a Magnesium alloy molten metal or hydrogen rises, pore will generate to the cast piece after continuous casting, and the mechanical property as an ingredient of a cast piece will deteriorate.

[0004]

Conventionally, the Magnesium alloy cast even the final product through hot rolling etc., after manufacturing half-finished products by the product which passed through ingot manufacture, the precision casting product by pressure die casting, or continuous casting, and the approach of finishing it by machining further etc. has been taken.

[0005]

However, since the product manufactured with the aforementioned conventional method was manufactured through many processes, the manufacturing cost was high and these had also become the failure of spread in a common article.

[0006]

As above-mentioned, it is common knowledge from the former that the manufacture approach of requiring much manday by product manufacture is in the fabrication period of a product and a situation disadvantageous in respect of a manufacturing cost, and a radical cure about this point was desired.

[0007]

While adding to the molten metal of said host phase alloy presentation and making the patent reference 1 carry out cooling coagulation of the particle distribution hardener which made the host phase alloy which consists of an aluminum alloy or a Magnesium alloy distribute ceramic powder with the cooling rate of 10 degrees C/second or more, the manufacture approach of the particle distribution alloy which draws out and carries out continuous casting by 80-200mm withdrawal rate for /is indicated.

[0008]

However, this approach has a casting rate as slow as a part for 80-200mm/, and is an approach which there is a limitation in order to aim at the cost cut by the productivity drive, and was further limited to manufacture of the bar of a Magnesium alloy etc. Moreover, the publication about the continuous casting process which performs control of flow of the molten metal to the mold made into a solution technical problem does not have this invention in the patent reference 1, either.

[0009]

In the surface-of-hot-water level control equipment of the continuous casting mold which becomes the patent reference 2 from a submerged nozzle and a stopper, a submerged nozzle upper bed outside surface is the inclined plane or curved surface of a convex form, a stopper soffit section inner surface is a concave inclined plane or a concave curved surface, and the surface-of-hot-water level control equipment of the continuous casting mold which changes spacing of the clearance between a submerged nozzle up outside surface and a stopper soffit section inner surface, and adjusts a molten metal injection rate by a stopper's vertical movement is indicated.

Moreover, the patent reference 3 is equipped with the stopper combined with the pipe which has the hole of the direction of a vertical established in the pars basilaris ossis occipitalis of a container which holds molten metal, and its pipe, the stopper's lower part has plug structure inserted in the hole of HAIPU, and the impregnation control-of-flow equipment of the molten metal which makes the radius of curvature of the drawing hole of plug structure and the radius of curvature of the diameter expansion section of the soffit of a drawing hole twice [more than] a drawing hole diameter is indicated. Furthermore, tubed [which the upper bed section is made to project in a container and is inserted in the molten-metal runoff hole of the pars basilaris ossis occipitalis of the container for molten metal metals] is presented to the patent reference 4, and the submerged nozzle which prepared the breakthrough or the notch in the barrel wall of the upper bed section, and molten-metal control-of-flow equipment equipped with the flow control section of the shape of a rod fitted in possible [vertical movement] while sliding the nozzle hole on the soffit section are indicated.

[0010]

However, for each performing control of flow of a small cross section, it is necessary to make paths, such as a stopper rod, thin, and with the equipment indicated by the patent reference 2-4, there is a problem of being easy to produce the deflection and breakage of a rod etc. Therefore, it is difficult to apply the technique indicated by the aforementioned reference to the continuous casting process of the Magnesium alloy molten metal which used small cross-section mold.

[Patent reference 1]

Publication-number No. 302137 [five to] official report (a claim, paragraph [0016])

[Patent reference 2]

JP.5-7700.A (a claim, paragraph [0012])

[Patent reference 3]

JP.7-51837.A (claim and paragraph [0005] - [0007])

[Patent reference 4]

The registration utility model official report No. 3019445 official report (a utility model registration claim, paragraph [0004])

[0011]

[Problem(s) to be Solved by the Invention]

The technical problem of this invention is not to cause lock out, in case a Magnesium alloy molten metal is poured into the mold of a small cross section, but to secure good control-of-flow nature, and offer continuous casting equipment equipped with the control-of-flow equipment which has the continuous casting approach and the aforementioned function in which the Magnesium alloy cast piece of high quality can be obtained by low cost.

[0012]

[Means for Solving the Problem]

In order to attain an above-mentioned technical problem, based on the above mentioned conventional trouble, this invention persons did comparison examination of the control-of-flow property of a sliding gate method and a stopper method, and acquired the knowledge of following (a) - (c).

(a) While the good control characteristic is acquired also in the field where a flow rate is low by being able to secure good control-of-flow nature and making the aperture cross section small to necessary minimum by adjusting the cross section of an aperture, an aperture tends to blockade a sliding gate method in early stages of impregnation.

(b) the diameter of the need that a stopper method holds a stopper rod in a molten metal although the lock out in the early stages of impregnation cannot take place easily to a rod — thick — not carrying out — it does not obtain, but the cross section of a control section becomes large, the amount of responses becomes excessive to a control input, and precise control of flow is difficult.

[0013]

(c) In the hot water supply by the small cross-section nozzle of a Magnesium alloy molten metal, lock out prevention of a nozzle and a controllability with a good flow rate are indispensable, and the control system which has the advantage of the both sides of the above (a) and (b) is required.

[0014]

This invention is completed based on the above-mentioned knowledge, and the summary is in the continuous casting approach of a Magnesium alloy molten metal and continuous casting equipment which are shown in following (1) and (2).

[0015]

(1) It is the continuous casting approach which supplies a Magnesium alloy molten metal in mold through a molten metal maintenance container, and is made into a cast piece. It lets the internal surface of said molten metal maintenance container pass for the molten metal control-of-flow section which has opening for opening and the molten metal which flowed for the molten metal in said molten metal maintenance container to flow into molten metal control-of-flow circles to flow into said mold. The continuous casting approach of the Magnesium alloy molten metal which controls the molten metal flow rate supplied in said mold by making it advance or retreat in a molten metal maintenance container.

[0016]

(2) It is continuous casting equipment of a Magnesium alloy molten metal installed so that it was continuous casting equipment of the Magnesium alloy molten metal which has a molten metal maintenance container, the molten metal control-of-flow section, and mold, and said molten metal control-of-flow section might have opening for opening and the molten metal which flowed for the molten metal in said molten metal maintenance container to flow into the molten metal control-of-flow section to flow into said mold and penetration and retreat might be possible in a container through the internal surface of said molten metal maintenance container.

In this invention, "the internal surface of a molten metal maintenance container" means the internal surface of the pars basilaris ossis occipitalis of a molten metal maintenance container, and the internal surface of the side-attachment-wall section located below in the bath surface level of the molten metal of a molten metal maintenance container.

[0017]

[Embodiment of the Invention]

In order are quality and to obtain the continuous casting cast piece of low cost from having the property that the reactivity of a Magnesium alloy in an elevated temperature is high as aforementioned, and it absorbs oxygen and hydrogen so much, and degrades the mechanical property of the product after casting, the approach of intercepting contact in an atmospheric-air ambient atmosphere by adoption of a submerged nozzle etc. is adopted.

[0018]

This invention solved lock out prevention of two technical problems further generated when carrying out hot water supply of the Magnesium alloy molten metal using a small cross-section nozzle, i.e., good control-of-flow nature, and a nozzle as follows, and was completed.

[0019]

In the continuous casting of a Magnesium alloy molten metal, since a thin cast piece is required, the good control-of-flow nature of the molten metal in the so-called small cross-section passage where a cross section is small is [that the pressing-down load which can be set like the roll turner of degree process should be mitigated] indispensable.

Although what is necessary is just to make small the opening cross section of the control-of-flow section which constitutes control-of-flow equipment to necessary minimum in order to raise the precision of control of flow, if it does so, it will become easy to blockade opening and an alloy molten metal will not flow in early stages of the impregnation to mold especially in many cases. Drawing 8 is the conceptual diagram of hot-water-supply equipment which used the conventional sliding gate, and drawing 9 is the conceptual diagram of hot-water-supply equipment which used the conventional stopper.

[0020]

By making the sliding gate 9 of the control-of-flow device 2 installed in pars-basilaris-ossis-occipitalis opening of the molten metal maintenance containers 3, such as tundish, slide in the direction of an arrow head with the sliding gate driving gear 52, a sliding gate method adjusts the area of opening of a sliding gate, and has structure which controls the flow rate of molten steel 4 and is passed to a submerged nozzle 1.

[0021]

On the other hand, by the conventional stopper method, the molten metal control-of-flow device 2 has structure which laid the stopper 8 which a point fits into pars-basilaris-ossis-occipitalis opening of the molten metal maintenance container 3, and can blockade opening in it from the upper part of a molten metal maintenance container. By making a stopper go up and down in the direction of an arrow head with the stopper driving gear 51, the magnitude of the clearance between a stopper point and opening is adjusted, the flow rate of molten steel 4 is adjusted, and it passes to a submerged nozzle 1.

[0022]

No above-mentioned sliding gate methods and stopper methods are inapplicable to the continuous casting of a Magnesium alloy molten metal for the following reason.

That is, also in the field of a low flow rate, the good control characteristic is acquired by obtaining good control-of-flow nature and making opening area reduce to necessary minimum by adjusting the area of gate opening, but on the other hand opening tends to blockade a sliding gate method in early stages of impregnation.

the diameter of a rod on the other hand although the lock out in the early stages of impregnation cannot take place easily, since a stopper method has the need of holding a stopper rod in a hot molten metal — thick — not carrying out — it does not obtain, the cross section of a control section becomes large, therefore precise control of flow is difficult.

Then, this invention persons hit on an idea of the approach of performing control of flow, by inserting the control-of-flow section which has the advantage of both the above-mentioned methods into a molten metal maintenance container. The example which the control-of-flow section is advanced and retreated inside a container from the pars basilaris ossis occipitalis of a molten metal maintenance container, and performs control of flow to below is explained.

[0023]

Drawing 1 is drawing showing the control-of-flow approach of the Magnesium alloy molten metal of this invention, and the hot-water-supply equipment at the time of the molten metal impregnation to mold, and, similarly drawing 2 is drawing showing the hot-water-supply equipment at the time of a molten metal impregnation halt to mold. Moreover, drawing 3 is the sectional view of the direction of an A1-A2 section view in drawing 1.

The casing 24 of the molten metal control-of-flow device 2 is attached in the lower part of opening of the pars basilaris ossis occipitalis 32 of the magnesium molten metal maintenance container 3, and the molten metal control-of-flow section 21 which can operate up and down is included in it in casing. The molten metal control-of-flow section 21 has the opening 23 for opening 22, the tubular path 25, and this molten metal which have a longwise configuration for a magnesium molten metal to flow to flow into mold through a submerged nozzle 1, and opening 23 is connected with the submerged nozzle 1. With the control-of-flow section driving gear 5, the molten metal control-of-flow section can let the internal surface of a magnesium molten metal maintenance container pars basilaris ossis occipitalis pass, and can be advanced or (it operates upward) retreated in a molten metal maintenance container (it operates downward). Since the upper part of opening 22 projects in the interior side of a molten metal maintenance container (high location) rather than the internal surface of a magnesium molten metal maintenance container as shown in drawing 1 when the molten metal control-of-flow section advances into a molten metal maintenance container, opening 22 is exposed to the interior of a maintenance container, and the Magnesium alloy molten metal 4 flows into molten metal control-of-flow circles from the opening. The Magnesium alloy molten metal style 41 which flowed reaches opening 23 through the tubular path 25 of molten metal control-of-flow circles, turns into the runoff style 42 of a Magnesium alloy molten metal, and is further poured into mold through a submerged nozzle.

[0024]

Since the upper part of opening 22 sinks in a molten metal maintenance container exterior side (low location) rather than the internal surface of a magnesium molten metal maintenance container as shown in drawing 2 when the molten metal control-of-flow section retreats out of a molten metal maintenance container, opening which led to the interior of a maintenance container is lost, the inflow to the molten metal control-of-flow circles of a magnesium molten metal stops, and the impregnation style to mold stops.

Control of a molten metal flow rate controls the penetration die length of the molten metal control-of-flow section from a molten metal maintenance container inner surface to the interior of a container, and is performed by adjusting the exposure area of the opening 22 inside a molten metal maintenance container.

[0025]

In addition, although the above-mentioned explanation explained the example which inserts the molten metal control-of-flow section in the interior of a container from the pars basilaris ossis occipitalis of a molten metal maintenance container, you may make it insert the molten metal control-of-flow section from the side-attachment-wall section of a molten metal maintenance container according to the format of a continuous casting facility, or the tie in of a facility.

[0026]

Moreover, as for the direction which inserts the molten metal control-of-flow section in the interior of a container, it is desirable to consider as an abbreviation perpendicular to an insertion internal surface. It is because it is advantageous to the wall surface of a molten metal maintenance container in respect of the operability of installation of the construction at the time of preparing opening, and a molten metal control-of-flow section driving gear, a layout, and a facility, and a maintenance.

[0027]

[Example]

In order to check the effectiveness of this invention, the casting trial of a Magnesium alloy molten metal was performed using the continuous casting equipment shown in drawing 4. In addition, in the equipment of drawing 4, it is as above drawing 1 -3 having explained the part of hot-water-supply equipment.

[0028]

In drawing 4, the Magnesium alloy molten metal 4 in the molten metal maintenance container 3 had the flow rate controlled by the molten metal control-of-flow device 2, and was poured into the continuous casting mold 6 through the submerged nozzle 1. Control of flow of a Magnesium alloy molten metal was performed by controlling the penetration depth into the molten metal maintenance container of the molten metal control-of-flow section 21 (it illustrates in drawing 1 - drawing 3) within the molten metal control-of-flow device 2 by the control-of-flow section driving gear 5 so that the arrow head A in drawing 4 shows. In order to mitigate friction between a cast piece and mold and to prevent printing, the alloy molten metal was poured in vibrating mold up and down with mold rocking equipment 7, as shown in the arrow head B in drawing 4, the pinch roll 10 drew out the part of coagulation husks from the mold lower part, and the cast piece was obtained.

[Test condition]

- 1) Magnesium alloy : Mg-3%aluminum-1%Zn (melting point: 632 degrees C),
- 2) Pouring temperature (whenever [maintenance container internal temperature]) : 750 degrees C,
- 3) Ambient atmosphere : Ar gas ambient atmosphere,
- 4) Mold size : 10mm[in width-of-face / of 700mm / x thickness] x height of 300mm,
- 5) Mold construction material : SUS430,
- 6) Submerged nozzle configuration : a drum section (upper part) cross section is circular [with a diameter of 20mm], and a point (lower part) cross section is a flat configuration with a width of face [of 55mm] (cast piece cross direction), and a thickness (the cast piece thickness direction) of 7mm.

[0029]

Drawing 5 is drawing showing the configuration of the submerged nozzle used for the continuous casting equipment of this invention, (a) expresses the cutting plane by the field including a flat side, and (b) expresses the cutting plane by the field vertical to a flat side. Since the thickness of the mold of the cast piece thickness direction was as small as 10mm, the thing with a width of face [of 55mm] (cast piece cross direction) and a thickness (the cast piece thickness direction) of 7mm was used for the cross-section configuration of a submerged nozzle point.

- 7) Construction material of a submerged nozzle : SUS430,
- 8) Whenever [stoving temperature / of a submerged nozzle] : 700 degrees C,
- 9) Drawing rate : 0.5 m/min,
- 10) Drawing conditions : continuation drawing,
- 11) The configuration of opening for a molten metal inflow of the molten metal control-of-flow section : 30mm x breadth of 5mm of longwise, and 30mm x breadth of 7mm of longwise.

[0030]

Drawing 6 is drawing showing the example of a configuration of opening for a molten metal inflow in the molten metal control-of-flow section of this invention, (a) expresses an example with a 30mm x breadth [of longwise] of 5mm, and, as for (b), the configuration of opening expresses an example with a 30mm x breadth [of longwise] of 7mm, respectively.

[0031]

Although the one where the configuration of opening has the larger ratio of (longwise/breadth) becomes good [the control precision of a flow rate], since a possibility that opening may blockade conversely also becomes high, both balance needs to determine. In the trial, the thing of the configuration longwise [whose] is 30mm and whose breadth is 5mm, and the thing of the configuration 30mm and whose breadth longwise is 7mm were used as above-mentioned.

[0032]

A trial is an example of this invention and followed the trial 1 whose opening configuration of the control-of-flow section is 30mmx5mm, the trial 2 whose opening configuration is similarly 30mmx7mm, and control of flow at the trial 3 using the conventional stopper, and the trial 4 using the same conventional sliding gate. Trial 3 and trial 4 are trials as an example of a comparison.

A test result is shown in a table 1.

[0033]

[A table 1]

表 1

項 目	試験 1	試験 2	試験 3	試験 4
溶湯流量制御部の開口部 形状、又は制御方式	30mm×5mm	30mm×7mm	従来型ストッパ-	従来型スライディングゲート
開口率 (%)	98	98	90	60
平均湯面変動幅 (mm)	±3	±3～±4	±10	±5

(注) : 開口率 = 開口チャージ数 / 全チャージ数 (週間平均)

平均湯面変動幅 = 1 チャージ内の平均湯面変動幅 (週間平均)

[0034]

A "numerical aperture" and "average surface-of-hot-water rate of change" of a control-of-flow device estimated

assessment of a test result.

[0035]

A numerical aperture (%) is the value which displayed the rate of the number of charges which was able to carry out opening at the time of the alloy molten metal impregnation initiation to mold by the percentage to the total number of casting charges of the Magnesium alloy molten metal per week.

The average surface-of-hot-water range of fluctuation (**mm) is the value which averaged the average surface-of-hot-water range of fluctuation within 1 charge about all casting charges per week.

[0036]

Trial 1 and trial 2 of the example of this invention have a high numerical aperture compared with trial 3 and trial 4 of the example of a comparison, and the result shown in a table 1 shows that the average surface-of-hot-water range of fluctuation is stopped low. Therefore, improvement in availability of continuous casting operation and stabilization of operation are attained by operation of this invention, and improvement in cast piece surface quality is also further attained by reduction of the surface-of-hot-water range of fluctuation.

[0037]

Furthermore, it is as follows when trial 1 and trial 2 of the example of this invention are compared.

[0038]

Drawing 7 is drawing which expressed the relation between the penetration depth of control-of-flow section opening into a molten metal maintenance container, and the opening cross section about trial 1 and trial 2 of the example of this invention.

[0039]

Although the opening cross section was increased by enlarging breadth of opening in the trial 2 from a viewpoint which prevents lock out of opening as compared with the trial 1, the numerical aperture did not have the case of trial 1, and the difference. Moreover, although the average surface-of-hot-water range of fluctuation increased slightly in the trial 2, it was the minute amount which does not pose a problem at all in respect of control of flow.

[0040]

In addition, the approach and equipment of this invention are suitable when using the submerged nozzle whose drum section bore of a submerged nozzle is 10-30mm. The submerged nozzle with such a thin bore is suitable for the activity for the small cross-section mold whose mold thickness of for example, the cast piece thickness direction is about 10-100mm. moreover, mold thickness — about 10mm and **** — in the case of thin thickness, the continuous casting approach of this invention can be enforced by considering as an extreme flat configuration and making thickness of a nozzle point still thinner than mold thickness as the point of a submerged nozzle is shown in said drawing 5.

[0041]

[Effect of the Invention]

Since a Magnesium alloy molten metal can be poured into the mold of a small cross section at the basis of control-of-flow nature good [without causing lock out] according to the continuous casting approach of this invention, the Magnesium alloy cast piece of high quality can be manufactured by low cost. Moreover, continuous casting equipment equipped with the control-of-flow equipment of this invention is suitable to enforce the above-mentioned casting approach, and contributes the approach and equipment of this invention to development of the manufacture field of a Magnesium alloy cast piece greatly.

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the control-of-flow approach of the Magnesium alloy molten metal of this invention, and the hot-water-supply equipment at the time of the molten metal impregnation to mold.

[Drawing 2]

At the time of a molten metal impregnation halt to the control-of-flow approach of the Magnesium alloy molten metal of this invention, and mold

It is drawing showing ***** equipment.

[Drawing 3]

It is the sectional view of the direction of an A1-A2 section view in drawing 1.

[Drawing 4]

It is the conceptual diagram showing the whole continuous casting equipment configuration of this invention.

[Drawing 5]

It is drawing showing the configuration of the submerged nozzle used for the continuous casting equipment of this invention, and (a) is **.

It is a table about the cutting plane express the cutting plane by the field including a flat surface, and according [(b)] to a field vertical to a flat side.

**,

[Drawing 6]

It is drawing showing the example of a configuration of opening for a molten metal inflow in the molten metal control-of-flow section of this invention.

For (a), the configuration of opening expresses an example with a 30mm x breadth [of longwise] of 5mm, and (b) is length.

An example with a die-length [of 30mm] x breadth of 7mm is expressed.

[Drawing 7]

Seki of the penetration depth of control-of-flow section opening of this invention into a molten metal maintenance container, and the opening cross section

It is drawing showing charge.

[Drawing 8]

It is the conceptual diagram of the hot-water-supply equipment using the conventional sliding gate.

[Drawing 9]

It is the conceptual diagram of the hot-water-supply equipment using the conventional stopper.

[Description of Notations]

- 1: Submerged nozzle,
 - 2: Molten metal control-of-flow device,
 - 21: Molten metal control-of-flow section,
 - 22: Opening,
 - 23: Opening,
 - 24: Casing of a molten metal control-of-flow device,
 - 25: Tubular path,
 - 3: Molten metal maintenance container,
 - 31: Molten metal maintenance container side-attachment-wall section,
 - 32: Molten metal maintenance container pars basilaris ossis occipitalis,
 - 4: A Magnesium alloy molten metal, molten steel,
 - 41: The inflow style of the Magnesium alloy molten metal to the molten metal control-of-flow section,
 - 42: The runoff style of the Magnesium alloy molten metal from the molten metal control-of-flow section,
 - 5: Control-of-flow section driving gear,
 - 51: Stopper driving gear,
 - 52: Sliding gate driving gear,
 - 6: Continuous casting mold,
 - 7: Mold rocking equipment,
 - 8: Stopper,
 - 9: Sliding gate,
 - 10: Pinch roll.
-

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the control-of-flow approach of the Magnesium alloy molten metal of this invention, and the hot-water-supply equipment at the time of the molten metal impregnation to mold.

[Drawing 2]

At the time of a molten metal impregnation halt to the control-of-flow approach of the Magnesium alloy molten metal of this invention, and mold

It is drawing showing ***** equipment.

[Drawing 3]

It is the sectional view of the direction of an A1-A2 section view in drawing 1.

[Drawing 4]

It is the conceptual diagram showing the whole continuous casting equipment configuration of this invention.

[Drawing 5]

It is drawing showing the configuration of the submerged nozzle used for the continuous casting equipment of this invention, and (a) is **.

It is a table about the cutting plane express the cutting plane by the field including a flat surface, and according [(b)] to a field vertical to a flat side.

**,

[Drawing 6]

It is drawing showing the example of a configuration of opening for a molten metal inflow in the molten metal control-of-flow section of this invention,

For (a), the configuration of opening expresses an example with a 30mm x breadth [of longwise] of 5mm, and (b) is length.

An example with a die-length [of 30mm] x breadth of 7mm is expressed.

[Drawing 7]

Seki of the penetration depth of control-of-flow section opening of this invention into a molten metal maintenance container, and the opening cross section

It is drawing showing charge.

[Drawing 8]

It is the conceptual diagram of the hot-water-supply equipment using the conventional sliding gate.

[Drawing 9]

It is the conceptual diagram of the hot-water-supply equipment using the conventional stopper.

[Description of Notations]

- 1: Submerged nozzle,
- 2: Molten metal control-of-flow device,
- 21: Molten metal control-of-flow section,
- 22: Opening,
- 23: Opening,
- 24: Casing of a molten metal control-of-flow device,
- 25: Tubular path,
- 3: Molten metal maintenance container,
- 31: Molten metal maintenance container side-attachment-wall section,
- 32: Molten metal maintenance container pars basilaris ossis occipitalis,
- 4: A Magnesium alloy molten metal, molten steel,
- 41: The inflow style of the Magnesium alloy molten metal to the molten metal control-of-flow section,
- 42: The runoff style of the Magnesium alloy molten metal from the molten metal control-of-flow section,
- 5: Control-of-flow section driving gear,
- 51: Stopper driving gear,
- 52: Sliding gate driving gear,
- 6: Continuous casting mold,
- 7: Mold rocking equipment,
- 8: Stopper,
- 9: Sliding gate,
- 10: Pinch roll.

[Translation done.]

(19) 日本国特許庁(JP)

(12) 公開特許公報(A)

(11) 特許出願公開番号

特開2004-188420

(P2004-188420A)

(43) 公開日 平成16年7月8日(2004.7.8)

(51) Int.Cl. ⁷	F I	テーマコード (参考)
B 2 2 D 11/00	B 2 2 D 11/00 D	4 E 0 0 4
B 2 2 D 11/10	B 2 2 D 11/10 3 1 O P	4 E 0 1 4
B 2 2 D 11/103	B 2 2 D 11/10 3 2 O D	
B 2 2 D 11/18	B 2 2 D 11/10 3 3 O B	
B 2 2 D 21/04	B 2 2 D 11/10 3 4 O Z	

審査請求 未請求 請求項の数 2 O L (全 11 頁) 最終頁に続く

(21) 出願番号 特願2002-355324 (P2002-355324)
(22) 出願日 平成14年12月6日 (2002.12.6)

(71) 出願人 000002118
住友金属工業株式会社
大阪府大阪市中央区北浜4丁目5番33号
(74) 代理人 100103481
弁理士 森 道雄
(74) 代理人 100083585
弁理士 穂上 照忠
(72) 発明者 村上 敏彦
大阪府大阪市中央区北浜4丁目5番33号
住友金属工業株式会社内
(72) 発明者 水上 英夫
大阪府大阪市中央区北浜4丁目5番33号
住友金属工業株式会社内

最終頁に続く

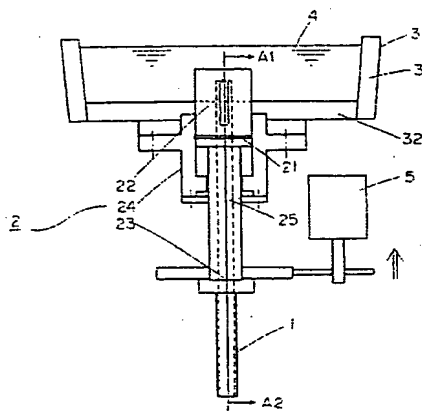
(54) 【発明の名称】 マグネシウム合金溶湯の連続鑄造方法および連続鑄造装置

(57) 【要約】

【課題】 溶湯を良好な流量制御性のもとに、低コストで鑄造できるマグネシウム合金の連続鑄造方法および連続鑄造装置の提供。

【解決手段】 マグネシウム合金溶湯4を溶湯保持容器3を経て鑄型内に供給して鑄片とする連続鑄造方法であって、前記溶湯保持容器内の溶湯が溶湯流量制御部21内に流入するための開口部22および流入した溶湯が前記鑄型に流出するための開口部23を有する溶湯流量制御部21を、前記溶湯保持容器の内壁面を通して、溶湯保持容器内に進入または後退させることにより、前記鑄型内に供給する溶湯流量を制御するマグネシウム合金溶湯の連続鑄造方法および連続鑄造装置。

【選択図】 図1



【特許請求の範囲】

【請求項1】

マグネシウム合金溶湯を溶湯保持容器を経て鑄型内に供給して鑄片とする連続鑄造方法であって、前記溶湯保持容器内の溶湯が溶湯流量制御部内に流入するための開口部および流入した溶湯が前記鑄型に流出するための開口部を有する溶湯流量制御部を、前記溶湯保持容器の内壁面を通して、溶湯保持容器内に進入または後退させることにより、前記鑄型内に供給する溶湯流量を制御することを特徴とするマグネシウム合金溶湯の連続鑄造方法。

【請求項2】

溶湯保持容器と、溶湯流量制御部と、鑄型とを有するマグネシウム合金溶湯の連続鑄造装置であって、前記溶湯流量制御部は、前記溶湯保持容器内の溶湯が溶湯流量制御部に流入するための開口部および流入した溶湯が前記鑄型に流出するための開口部を有し、前記溶湯保持容器の内壁面を通して容器内に進入および後退可能のように設置されたことを特徴とするマグネシウム合金溶湯の連続鑄造装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】

本発明は、連続鑄造用鑄型へのマグネシウム合金溶湯の良好な流量制御のできる連続鑄造方法、および前記流量制御機構を備えた連続鑄造装置に関する。

【0002】

【従来の技術】

マグネシウム合金は、実用合金中で最も比重が小さく、また剛性が高いため、航空機や自動車さらには携帯電話などに広く使用されている。特に、携帯電話などの急速な普及によりマグネシウム合金市場はさらに成長が期待され、安価で高品質のマグネシウム合金の提供が望まれている。

【0003】

マグネシウム合金は高温での反応性が高く、酸化されやすく、また水素を吸収しやすいことから、溶解や連続鑄造時にマグネシウム合金の溶湯が大気雰囲気下にさらされると、酸化が促進して酸化物が生成したり、溶解したマグネシウム合金中に酸素や水素が吸収されて、それらの濃度が著しく上昇することとなる。このようにマグネシウム合金溶湯中の酸素や水素の濃度が上昇すると、連続鑄造後の鑄片には気孔が生成したり、また、鑄片の材料としての機械的性質が低下したりする。

【0004】

従来、マグネシウム合金は、インゴット製造を経た製品、ダイカスト法による精密鑄造製品、または連続鑄造によって半製品を製造した後、熱間圧延などを経て最終製品まで成型し、さらにそれを機械加工により仕上げる方法などが採られてきた。

【0005】

しかしながら、前記の従来法により製造した製品は、多数の工程を経て製造されるため、製造コストが高く、これらが一般品への普及の障害ともなっていた。

【0006】

上述のとおり、製品製造までに多くの工数を要する製造方法が、製品の製作期間および製造コストの面で不利な状況にあることは、従来から周知であり、この点についての抜本的対策が望まれていた。

【0007】

特許文献1には、セラミックス粉末をアルミニウム合金またはマグネシウム合金からなる母相合金に分散させた粒子分散母合金を、前記母相合金組成の溶湯に添加し、 $10^{\circ}\text{C}/\text{秒}$ 以上の冷却速度で冷却凝固させるとともに、 $80\sim 200\text{mm}/\text{分}$ の引抜速度で引き抜いて連続鑄造する粒子分散合金の製造方法が開示されている。

【0008】

しかし、この方法は、鑄造速度が $80\sim 200\text{mm}/\text{分}$ と遅く、生産性向上によるコストダウンを目指すためには限界があり、さらにマグネシウム合金の棒材などの製造に限定さ

れた方法である。また、特許文献1には、本発明が解決課題とする鑄型への溶湯の流量制御を行う連続鑄造法に関する記載もない。

【0009】

特許文献2には、浸漬ノズルとストッパーからなる連続鑄造鑄型の湯面レベル制御装置において、浸漬ノズル上端外面は凸形の傾斜面または曲面であり、ストッパー下端部内面は凹形の傾斜面または曲面であり、ストッパーの上下動により、浸漬ノズル上部外面とストッパー下端部内面との隙間の間隔を変更し、溶湯注入量を調整する連続鑄造鑄型の湯面レベル制御装置が開示されている。

また、特許文献3には、溶融金属を収容する容器の底部に設けられた鉛直方向の孔を有するパイプとそのパイプに組み合わされるストッパーを備え、そのストッパーの下部はパイプの孔に差し込まれる栓構造となっており、栓構造の絞り孔の曲率半径および絞り孔の下端の拡径部の曲率半径を、絞り孔直径の2倍以上とする溶湯の注入流量制御装置が開示されている。

さらに、特許文献4には、溶湯金属用容器の底部の溶融金属流出孔に上端部を容器内に突出させて挿着される筒状を呈し、上端部の筒壁に貫通孔または切欠きを設けた浸漬ノズルと、そのノズル孔に下端部を摺動させながら上下動可能に嵌挿したロッド状の流量調整部を備える溶融金属流量制御装置が開示されている。

【0010】

しかし、特許文献2～4に開示された装置では、いずれも小断面の流量制御を行うにはストッパーロッドなどの径を細くする必要があり、ロッドなどの曲がりや折損が生じやすいという問題がある。したがって、前記の文献に開示された技術を小断面鑄型を使用したマグネシウム合金溶湯の連続鑄造法に適用することは困難である。

【特許文献1】

特開平5-302137号公報（特許請求の範囲、段落【0016】）

【特許文献2】

特開平5-7700号公報（特許請求の範囲、段落【0012】）

【特許文献3】

特開平7-51837号公報（特許請求の範囲、段落【0005】～【0007】）

【特許文献4】

登録実用新案公報第3019445号公報（実用新案登録請求の範囲、段落【0004】）

【0011】

【発明が解決しようとする課題】

本発明の課題は、マグネシウム合金溶湯を小断面の鑄型に注入する際に閉塞を起こさず、良好な流量制御性を確保して、低コストで高品質のマグネシウム合金鑄片を得ることができる連続鑄造方法および前記の機能を有する流量制御装置を備えた連続鑄造装置を提供することにある。

【0012】

【課題を解決するための手段】

本発明者らは、上述の課題を達成するために、前記した従来の問題点を踏まえて、スライディングゲート方式およびストッパー方式の流量制御特性を比較検討し、下記の（a）～（c）の知見を得た。

（a）スライディングゲート方式は、開孔部の断面積を調整することにより良好な流量制御性を確保でき、開孔部断面積を必要最低限まで小さくすることにより、流量の低い領域においても良好な制御特性が得られる反面、注入初期に開孔部が閉塞しやすい。

（b）ストッパー方式は、注入初期における閉塞は起こりにくい、溶湯中でストッパーロッドを保持する必要性から、ロッドの直径を太くせざるを得ず、制御部の断面積が大きくなって、操作量に対して応答量が過大となり、精密な流量制御は困難である。

【0013】

（c）マグネシウム合金溶湯の小断面ノズルによる給湯においては、ノズルの閉塞防止お

よび流量の良好な制御性が不可欠であり、上記（a）および（b）の双方の長所を兼ね備えた制御方式が必要である。

【0014】

本発明は、上記の知見に基づいて完成されたものであり、その要旨は、下記の（1）および（2）に示すマグネシウム合金溶湯の連続鑄造方法および連続鑄造装置にある。

【0015】

（1）マグネシウム合金溶湯を溶湯保持容器を経て鑄型内に供給して鑄片とする連続鑄造方法であって、前記溶湯保持容器内の溶湯が溶湯流量制御部内に流入するための開口部および流入した溶湯が前記鑄型に流出するための開口部を有する溶湯流量制御部を、前記溶湯保持容器の内壁面を通して、溶湯保持容器内に進入または後退させることにより、前記鑄型内に供給する溶湯流量を制御するマグネシウム合金溶湯の連続鑄造方法。

【0016】

（2）溶湯保持容器と、溶湯流量制御部と、鑄型とを有するマグネシウム合金溶湯の連続鑄造装置であって、前記溶湯流量制御部は、前記溶湯保持容器内の溶湯が溶湯流量制御部に流入するための開口部および流入した溶湯が前記鑄型に流出するための開口部を有し、前記溶湯保持容器の内壁面を通して容器内に進入および後退可能なように設置されたマグネシウム合金溶湯の連続鑄造装置。

本発明において、「溶湯保持容器の内壁面」とは、溶湯保持容器の底部の内壁面、および溶湯保持容器の溶湯の浴面水準以下に位置する側壁部の内壁面を意味する。

【0017】

【発明の実施の形態】

マグネシウム合金は、前記のとおり、高温での反応性が高く、また、酸素や水素を多量に吸収して鑄造後の製品の機械的特性を劣化させる特性を有することから、高品質で低コストの連続鑄造鑄片を得るためには、浸漬ノズルなどの採用により、大気雰囲気との接触を遮断する方法が採用される。

【0018】

本発明は、さらに、マグネシウム合金溶湯を小断面ノズルを用いて給湯する場合に発生する2つの課題、すなわち良好な流量制御性およびノズルの閉塞防止を以下のとおり解決して、完成された。

【0019】

マグネシウム合金溶湯の連続鑄造においては、次工程の圧延工程における圧下負荷を軽減すべく、薄厚鑄片が要求されることから、断面の小さい、いわゆる小断面流路における溶湯の良好な流量制御性が不可欠である。

流量制御の精度を向上させるためには、流量制御装置を構成する流量制御部の開口部断面積を必要最小限まで小さくすればよいが、そうすると、開口部が閉塞しやすくなり、特に、鑄型への注入初期に合金溶湯が流れなくなる場合が多い。図8は、従来のスライディングゲートを用いた給湯装置の概念図であり、図9は、従来のストッパーを用いた給湯装置の概念図である。

【0020】

スライディングゲート方式は、タンディッシュなどの溶湯保持容器3の底部開口部に設置した流量制御機構2のスライディングゲート9をスライディングゲート駆動装置52により矢印の方向にスライドさせることにより、スライディングゲートの開口部の面積を調整し、溶鋼4の流量を制御して浸漬ノズル1に流す構造となっている。

【0021】

一方、従来のストッパー方式では、溶湯流量制御機構2は、溶湯保持容器3の底部開口部に、先端部が嵌り込んで開口部を閉塞することのできるストッパー8を、溶湯保持容器の上部から載置した構造となっている。ストッパーをストッパー駆動装置51により矢印の方向に上下させることにより、ストッパー先端部と開口部との隙間の大きさを調整し、溶鋼4の流量を調整して浸漬ノズル1に流す。

【0022】

上記のスライディングゲート方式およびストッパー方式は、何れも下記の理由により、マグネシウム合金溶湯の連続鑄造には適用できない。

すなわち、スライディングゲート方式は、ゲート開口部の面積を調整することにより良好な流量制御性が得られ、開口部面積を必要最低限まで縮小させることにより、低流量の領域においても良好な制御特性が得られるが、その反面、注入初期に開口部が閉塞しやすい。

一方、ストッパー方式は、注入初期における閉塞は起こりにくい、高温の溶湯中でストッパーロッドを保持する必要のあることから、ロッドの直径を太くせざるを得ず、制御部の断面積が大きくなり、したがって、精密な流量制御は困難である。

そこで、本発明者は、溶湯保持容器内に上記の両方式の長所を兼ね備えた流量制御部を挿入することにより、流量制御を行う方法を想到した。以下に、溶湯保持容器の底部から容器内部に流量制御部を進入および後退させて流量制御を行う例について説明する。

【0023】

図1は、本発明のマグネシウム合金溶湯の流量制御方法および鑄型への溶湯注入時の給湯装置を示す図であり、図2は、同じく、鑄型への溶湯注入停止時の給湯装置を示す図である。また、図3は、図1におけるA1-A2部矢視方向の断面図である。

マグネシウム溶湯保持容器3の底部32の開口部の下部には、溶湯流量制御機構2のケーシング24が取り付けられ、ケーシング内には上下に作動可能な溶湯流量制御部21が組み込まれている。溶湯流量制御部21は、マグネシウム溶湯が流入するための縦長の形状を有する開口部22、管状通路25および同溶湯が浸漬ノズル1を経て鑄型に流出するための開口部23を有し、開口部23は浸漬ノズル1と連結されている。

溶湯流量制御部は、流量制御部駆動装置5により、マグネシウム溶湯保持容器底部の内壁面を通して、溶湯保持容器内に進入（上向きに作動）または後退（下向きに作動）させることができる。溶湯流量制御部が溶湯保持容器内に進入した場合には、図1に示すとおり、開口部22の上部がマグネシウム溶湯保持容器の内壁面よりも溶湯保持容器内部側（高い位置）に突出するため、開口部22が保持容器内部に露出し、マグネシウム合金溶湯4がその開口部から溶湯流量制御部内に流入する。流入したマグネシウム合金溶湯流41は、溶湯流量制御部内の管状通路25を経て開口部23に達し、マグネシウム合金溶湯の流出流42となってさらに浸漬ノズルを経て鑄型に注入される。

【0024】

溶湯流量制御部が溶湯保持容器内から後退した場合には、図2に示されるとおり、開口部22の上部がマグネシウム溶湯保持容器の内壁面よりも溶湯保持容器外部側（低い位置）に沈み込むため、保持容器内部と通じた開口部はなくなり、マグネシウム溶湯の溶湯流量制御部内への流入は停止し、鑄型への注入流は停止する。

溶湯流量の制御は、溶湯保持容器内面から容器内部への溶湯流量制御部の進入長さを制御して、溶湯保持容器内部への開口部22の露出面積を調整することにより行う。

【0025】

なお、上記の説明では、溶湯保持容器の底部から容器内部に溶湯流量制御部を挿入する例について説明したが、連続鑄造設備の形式または設備の取り合いに応じて、溶湯保持容器の側壁部から溶湯流量制御部を挿入するようにしてもよい。

【0026】

また、溶湯流量制御部を容器内部に挿入する方向は、挿入内壁面に対して略垂直とするのが好ましい。溶湯保持容器の壁面に開口部を設ける際の施工、溶湯流量制御部駆動装置の据付けおよびレイアウト、ならびに設備の操作性および維持管理の面で有利だからである。

【0027】

【実施例】

本発明の効果を確認するため、図4に示す連続鑄造装置を用いてマグネシウム合金溶湯の鑄造試験を行った。なお、図4の装置において、給湯装置の部分については、前記の図1～3にて説明したとおりである。

【0028】

図4において、溶湯保持容器3内のマグネシウム合金溶湯4は、溶湯流量制御機構2により流量を制御され、浸漬ノズル1を経て連続鑄造鑄型6に注入された。マグネシウム合金溶湯の流量制御は、流量制御部駆動装置5により溶湯流量制御機構2内の溶湯流量制御部21（図1～図3にて図示）の溶湯保持容器内への進入深さを、図4中の矢印Aで示すように制御することにより行った。鑄片と鑄型との間の摩擦を軽減して焼き付きを防止するために、鑄型振動装置7により鑄型を、図4中の矢印Bに示すように上下に振動させながら合金溶湯を注入し、鑄型下部から凝固殻の部分をピンチロール10により引き抜いて鑄片を得た。

【試験条件】

- 1) マグネシウム合金：Mg-3%A1-1%Zn（融点：632℃）、
- 2) 注湯温度（保持容器内温度）：750℃、
- 3) 雰囲気：Arガス雰囲気、
- 4) 鑄型サイズ：幅700mm×厚さ10mm×高さ300mm、
- 5) 鑄型材質：SUS430、
- 6) 浸漬ノズル形状：胴部（上部）断面は直径20mmの円形、先端部（下部）断面は幅（鑄片幅方向）55mm、厚さ（鑄片厚さ方向）7mmの扁平形状。

【0029】

図5は、本発明の連続鑄造装置に用いた浸漬ノズルの形状を示す図であり、(a)は扁平面を含む面による切断面を表し、(b)は扁平面と垂直な面による切断面を表す。鑄片厚さ方向の鑄型の厚さが10mmと小さいことから、浸漬ノズル先端部の断面形状は、幅（鑄片幅方向）55mm、厚さ（鑄片厚さ方向）7mmのものをを用いた。

- 7) 浸漬ノズルの材質：SUS430、
- 8) 浸漬ノズルの加熱温度：700℃、
- 9) 引き抜き速度：0.5m/min、
- 10) 引き抜き条件：連続引き抜き、
- 11) 溶湯流量制御部の溶湯流入用開口部の形状：縦長さ30mm×横幅5mm、および縦長さ30mm×横幅7mm。

【0030】

図6は、本発明の溶湯流量制御部における溶湯流入用開口部の形状例を示す図であり、(a)は開口部の形状が、縦長さ30mm×横幅5mmの例を、(b)は縦長さ30mm×横幅7mmの例をそれぞれ表す。

【0031】

開口部の形状は、（縦長さ／横幅）の比が大きい方が、流量の制御精度は良好となるが、逆に開口部が閉塞する恐れも高くなるため、両者のバランスにより決定する必要がある。試験では、上記のとおり、縦長さが30mm、横幅が5mmの形状のもの、および縦長さが30mm、横幅が7mmの形状のものをを用いた。

【0032】

試験は、本発明例であって、流量制御部の開口部形状が30mm×5mmの試験1、同じく開口部形状が30mm×7mmの試験2、流量制御に従来のストッパーを用いた試験3、および同じく従来のスライディングゲートを用いた試験4について行った。試験3および試験4は、比較例としての試験である。

表1に試験結果を示す。

【0033】

【表1】

表1

項 目	試験1	試験2	試験3	試験4
溶湯流量制御部の開口部 形状、又は制御方式	30mm×5mm	30mm×7mm	従来型ストップ-	従来型スライディングゲート
開口率 (%)	98	98	90	60
平均湯面変動幅 (mm)	±3	±3～±4	±10	±5

(注)：開口率＝開口チャージ数／全チャージ数 (週間平均)

平均湯面変動幅＝1チャージ内の平均湯面変動幅 (週間平均)

【0034】

試験結果の評価は、流量制御機構の「開口率」および「平均湯面変動率」により評価した。

【0035】

開口率(%)とは、1週間当たりのマグネシウム合金溶湯の全鑄造チャージ数に対して、鑄型への合金溶湯注入開始時に開口できたチャージ数の割合を百分率にて表示した値である。

平均湯面変動幅(±mm)とは、1チャージ内での平均湯面変動幅を1週間当たりの全鑄造チャージについて平均した値である。

【0036】

表1に示された結果から、本発明例の試験1および試験2は、比較例の試験3および試験4に比べて、開口率が高く、また平均湯面変動幅は低く抑えられていることがわかる。したがって、本発明の実施により、連続鑄造操業の稼働率向上と操業の安定化が図られ、さらに湯面変動幅の減少により鑄片表面品質の向上も達成される。

【0037】

さらに、本発明例の試験1と試験2とを比較すると以下のとおりである。

【0038】

図7は、本発明例の試験1と試験2について、溶湯保持容器内への流量制御部開口部の進入深さと開口断面積との関係を表した図である。

【0039】

試験2では、開口部の閉塞を防止する観点から、試験1に比して、開口部の横幅を大きくすることにより開口断面積を増大させたが、開口率は、試験1の場合と差はなかった。また、試験2では、平均湯面変動幅がわずかに増大したが、流量制御の面では全く問題とならない微小な量であった。

【0040】

なお、本発明の方法および装置は、浸漬ノズルの胴部内径が10～30mmである浸漬ノズルを用いる場合に好適である。このような内径の細い浸漬ノズルは、例えば、鑄片厚さ方向の鑄型厚さが10～100mm程度の小断面鑄型を対象とした使用に適している。また、鑄型厚さが10mm程度と極く薄い厚さの場合は、浸漬ノズルの先端部を前記図5に示すとおり、極端な偏平形状とし、ノズル先端部の厚さを鑄型厚さよりもさらに薄くすることにより、本発明の連続鑄造方法を実施することができる。

【0041】

【発明の効果】

本発明の連続鑄造方法によれば、マグネシウム合金溶湯を、閉塞を起こさずに良好な流量制御性のもとに、小断面の鑄型に注入することができるので、低コストで高品質のマグネシウム合金鑄片を製造できる。また、本発明の流量制御装置を備えた連続鑄造装置は、上記の鑄造方法を実施するのに好適であり、本発明の方法および装置は、マグネシウム合金鑄片の製造分野の発展に大きく寄与する。

【図面の簡単な説明】

【図1】本発明のマグネシウム合金溶湯の流量制御方法および鑄型への溶湯注入時の給湯

装置を示す図である。

【図2】

本発明のマグネシウム合金溶湯の流量制御方法および鑄型への溶湯注入停止時の給湯装置を示す図である。

【図3】

図1におけるA1-A2部矢視方向の断面図である。

【図4】

本発明の連続鑄造装置の全体構成を示す概念図である。

【図5】

本発明の連続鑄造装置に用いる浸漬ノズルの形状を示す図であり、(a)は偏平面を含む面による切断面を表し、(b)は偏平面と垂直な面による切断面を表す。

【図6】

本発明の溶湯流量制御部における溶湯流入用開口部の形状例を示す図であり、(a)は開口部の形状が、縦長さ30mm×横幅5mmの例を表し、(b)は縦長さ30mm×横幅7mmの例を表す。

【図7】

溶湯保持容器内への本発明の流量制御部開口部の進入深さと開口断面積との関係を表す図である。

【図8】

従来のスライディングゲートを用いた給湯装置の概念図である。

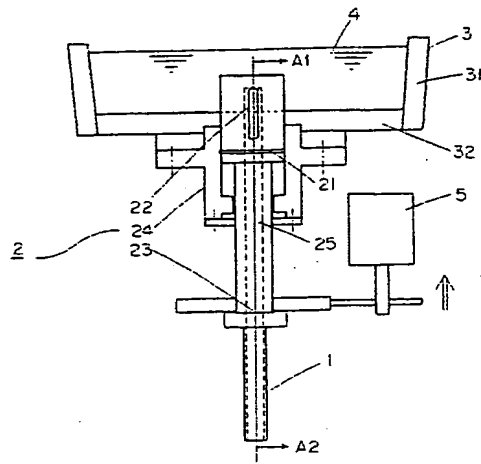
【図9】

従来のストッパーを用いた給湯装置の概念図である。

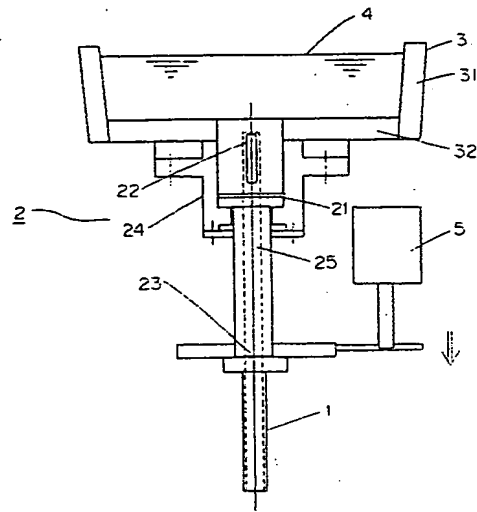
【符号の説明】

- 1：浸漬ノズル、
- 2：溶湯流量制御機構、
- 21：溶湯流量制御部、
- 22：開口部、
- 23：開口部、
- 24：溶湯流量制御機構のケーシング、
- 25：管状通路、
- 3：溶湯保持容器、
- 31：溶湯保持容器側壁部、
- 32：溶湯保持容器底部、
- 4：マグネシウム合金溶湯、溶鋼、
- 41：溶湯流量制御部へのマグネシウム合金溶湯の流入流、
- 42：溶湯流量制御部からのマグネシウム合金溶湯の流出流、
- 5：流量制御部駆動装置、
- 51：ストッパー駆動装置、
- 52：スライディングゲート駆動装置、
- 6：連続鑄造鑄型、
- 7：鑄型振動装置、
- 8：ストッパー、
- 9：スライディングゲート、
- 10：ピンチロール。

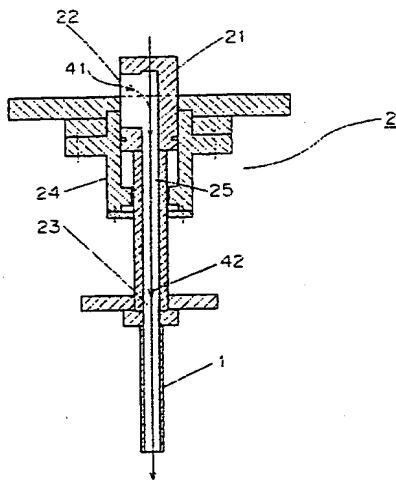
【図1】



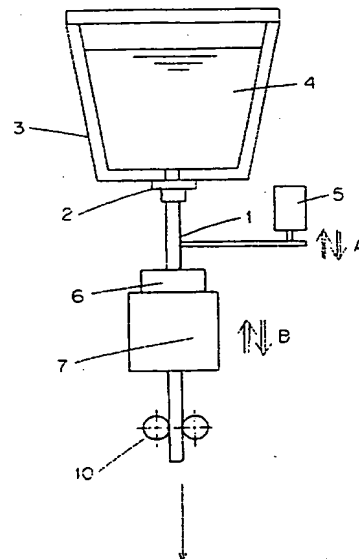
【図2】



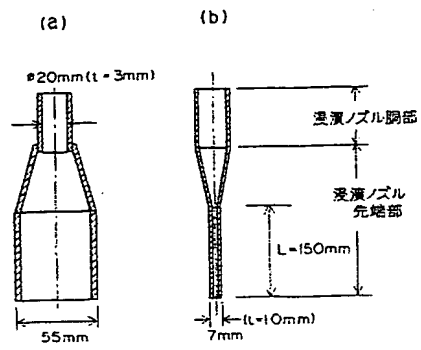
【図3】



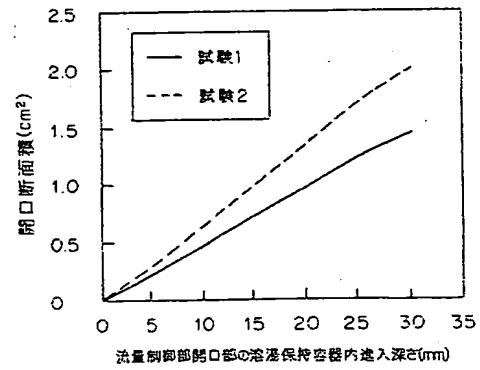
【図4】



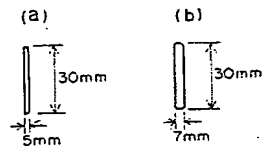
【図5】



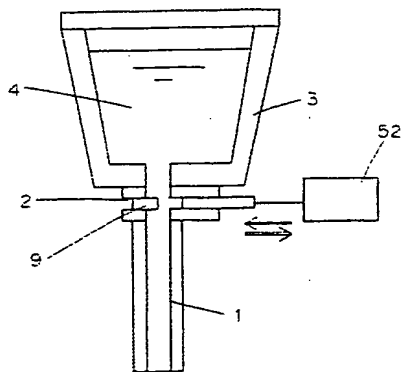
【図7】



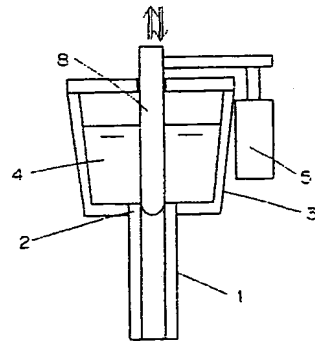
【図6】



【図8】



【図9】



フロントページの続き

(51) Int. Cl. 7

F 1

テーマコード (参考)

B 2 2 D 37/00

B 2 2 D 11/103

B

B 2 2 D 41/14

B 2 2 D 11/103

Z

B 2 2 D 41/22

B 2 2 D 11/18

J

B 2 2 D 41/50

B 2 2 D 11/18

Z

B 2 2 D 21/04

B

B 2 2 D 37/00

B

B 2 2 D 41/14

B 2 2 D 41/22

B 2 2 D 41/50 5 1 0

(72) 発明者 石川 稔

大阪府大阪市中央区北浜4丁目5番33号

住友金属工業株式会社内

Fターム(参考) 4E004 FA00 FA01 FB01 MB06 MB09 NA02 NC09

4E014 DB03 LA01 MA01 MA02